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PROVISIONAL SPECIFICATION

Invention Title:

IMPROVED PET CONTAINER

The invention is described in the following statement:

Our Ref: 031057

IMPROVED PET CONTAINER

The present invention relates to a preform from which a container with an integrally connected hollow handle may be biaxially blown and a method of manufacture thereof and, more particularly to a preform and resulting container having a handle integrally connected at at least two separate points.

10 BACKGROUND

Attempts have been made to incorporate integral handles in PET and like injection blow moulded containers - for example see US 4,629,598 to Thompson, assigned to Tri-Tech Systems International, Inc. The preform or preform from which the handled bottles of US 4,629,598 are produced is illustrated in Fig. 1. To date, however, attempts to produce a practical, mass produced version of this arrangement have been unsuccessful. Instead, the best that appears to have been done in commercial practice is an arrangement whereby the blown containers are arranged to accept a clip-on or snap-on handle in a separate production step after the container itself is formed. See for example WO82/02371 and WO82/02370, both to Thompson.

Injection-stretch-blow moulding is a process in which the preform is stretched both axially and radially, resulting in biaxial orientation of the polymer.

Biaxial orientation provides increased tensile strength (top load), less permeation due to tighter alignment of the molecules, improved drop impact, clarity, and weight reduction of the container.

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Not all thermoplastics can be oriented. The major thermoplastics used are polyethylene terephthalate (PET), polyacrylonitrile (PAN), polyvinyl chloride (PVC), and polypropylene (PP). PET is by far the largest volume material, followed by PVC, PP, and PAN.

The amorphous materials, e.g., PET, with a wide range of thermoplasticity are easier to stretch-blow than the partially crystalline types such as PP. Approximate melt and stretch temperatures to yield maximum container properties are:

Material	Melt, Degrees C.	Stretch, Degrees C.
PET	280	107
PVC	180	120
PAN	210	120
PP	240	160

There are basically two types of processes for stretch-blow moulding:

- 1) single-stage in which preforms are made and bottles blown on the same machine, and
- 2) two-stage in which preforms are made on one machine and blown later on another machine.

Single-stage equipment is capable of processing PVC, PET, and PP. Once the preform is formed (either extruded or injection moulded), it passes through conditioning stations which bring it to the proper orientation temperature. The single-stage system allows the process to proceed from raw material to finished product in one machine, but since tooling cannot be easily changed, the

process is best suited for dedicated applications and low volumes.

Oriented PVC containers most commonly are made on single-stage, extrusion-type machines. The preform is
5 extruded on either single- or double-head units. Temperature conditioning, stretching, and thread forming are done in a variety of ways depending on the design of the machine. Many of the processes presently in use are proprietary.

10 Many oriented PET containers are produced on single-stage machines. Preforms are first injection moulded, then transferred to a temperature conditioning station, then to the stretch-blow moulding operation where the preforms are stretch-blown into bottles, and finally to an eject
15 station.

With the two-stage process, processing parameters for both preform manufacturing and bottle blowing can be optimized. A processor does not have to make compromises for preform design and weight, production rates, and bottle
20 quality as he does on single-stage equipment. He can either make or buy preforms. And if he chooses to make them, he can do so in one or more locations suitable to his market. Both high-output machines and low output machines are available. Heretofore two stage extrusion-type machines
25 generally have been used to make oriented PP bottles. In a typical process, preforms are re-extruded, cooled, cut to

length, reheated, stretched while the neck finish is being trimmed, and ejected.

It is an object of the present invention to address or ameliorate at least some of the above disadvantages.

5 **BRIEF DESCRIPTION OF INVENTION**

Accordingly in one broad form of the invention there is provided a preform for a stretch-blow moulded container comprised of orientable plastic material and arranged so that the resultant stretch-blow moulded container includes
10 an integrally moulded hollow handle; said preform comprising a moulded structure having a neck portion and an expandable portion below the neck and a hollow handle portion; said hollow handle portion extending from a first upper junction point to a second lower junction point on
15 said expandable portion and wherein interior surfaces of said hollow handle portion form a continuum with interior surfaces of said expandable portion.

In a further broad form of the invention there is provided a system for the stretch-blow moulding of a
20 container comprised of orientable plastic material; said container provided with an integral hollow handle; said handle being in communication with the interior of said container at both a first upper junction point and a second lower junction point.

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Preferably containers are formed in a two-stage process.

Preferably a first process of said two-stage process includes producing a preform by injection moulding.

5 Preferably a second process of said two-stage process includes producing said container from said preform by stretch-blow moulding of said preform.

Preferably said preform comprises:

- 10 (a) a neck portion including a threaded upper portion and a locating ring portion,
- (b) an expandable elongate cylindrical body portion depending from said neck portion and closed at a lower end,
- 15 (c) a generally arcuate hollow handle portion integrally connected to said elongate cylindrical body portion at a first upper junction point and a second lower junction point.

Preferably said preform is injection moulded in a mould cavity of an injection die provided with a main body
20 mandrel and a handle mandrel.

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Preferably said main body mandrel is adapted to define internal surfaces of said elongate cylindrical body portion.

Preferably said handle mandrel is adapted to define
5 internal surfaces of said hollow handle portion.

Preferably said mould cavity is adapted to define external surfaces of said elongate cylindrical body portion and said arcuate hollow handle portion.

Preferably main body mandrel is of an elongate
10 cylindrical form; the upper end of said elongate cylindrical form extending through said neck portion so as to communicate with a handle mandrel control module external to said injection die.

Preferably said main body mandrel is provided with an
15 internal passage passing from said handle mandrel control module to said first upper junction point below said neck portion; said internal passage curving outwardly to end at an opening in the external surface of said main body mandrel.

20 Preferably said handle mandrel is comprised of a heat resistant, flexible shape retaining material adapted for sliding insertion through said internal passage.

Preferably said flexible shape retaining material of said handle mandrel is conditioned to form a lower portion of said handle mandrel so as to conform to a median line of said hollow handle portion when said lower portion is
5 unrestrained.

Preferably said lower portion of said handle mandrel is adapted for sliding extension from said internal passage to adopt a shape conforming to said median line; a lower tip portion of said lower portion adapted to nest in a
10 pocket provided in said main body mandrel at said second lower junction point.

In a further broad form of the invention there is provided a method for the production of a preform for a blow-stretch-moulded container having an integral hollow
15 handle said method including the steps of:

- (a) Placing a mandrel assembly comprising a main mandrel portion and a retractable handle mandrel portion within a preform injection moulding cavity; said cavity having a main body portion and a hollow handle portion,
20
- (b) Extending a retractable handle mandrel portion from said mandrel assembly so as to define a median line of said hollow handle portion,

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(c) Injecting PET into said cavity so as to fill voids between said cavity and said mandrel assembly so as to form said preform,

5 (d) Retracting said retractable handle mandrel portion to within said main body portion of said mandrel assembly,

(e) Ejecting said preform off said mandrel assembly.

10 Preferably said retractable handle mandrel portion is adapted for extension between a first retracted state within said main body portion of said mandrel and an extended state wherein said handle mandrel defines said median line of said hollow handle portion.

15 In yet a further broad form of the invention there is provided a method for the production of a container having an integrally formed hollow handle by a two-stage process; said process including the steps of:

(a) preparing a preform having a hollow handle portion by injection moulding,

(b) stretch-blow-moulding said container.

20 Preferably said method including the further steps of;

- 10 -

- (a) injection moulding said preform around a mandrel assembly having a main body portion and a handle portion,
- 5 (b) retracting said handle portion into said main body portion,
- (c) ejecting said preform from said mandrel assembly,
- (d) placing said preform into a stretch-blow-moulding die,
- stretch-blow-moulding said container.

10

BRIEF DESCRIPTION OF DRAWINGS

Embodiments of the present invention will now be described with reference to the accompanying drawings wherein:

15 Figure 1A is a side elevation view of a typical complete preform produced by a conventional injection moulding process according to prior art.

Figure 1B is a side elevation view of a container produced by a conventional stretch-blow-moulding process
20 from the preform of figure 1A.

Figure 2 shows a portion of a typical cavity and mandrel for a PET bottle preform in one half of an injection die according to prior art.

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Figure 3 shows a portion of an injection die cavity and mandrel arrangement for the production of a preform according to a preferred embodiment of the present invention

5 Figure 4 is a side elevation view of a preform produced from the injection die arrangement of figure 3.

Figure 5 shows a portion of a stretch-blow-moulding cavity for the production of a container from the preform of figure 4.

10 Figure 6 is a side elevation view of a stretch-blow-moulded container produced from the cavity of figure 5.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

According to prior art a typical preform as shown in
15 figure 1A for the production of a PET blow-moulded container as shown in figure 1B is produced by injection moulding as a first stage of a two-stage process.

The two-stage process is the lowest-cost method to produce oriented PET containers. The two-stage process,
20 which provides injection moulding of the preform and, if desired, subsequent shipping to stretch-blow-moulding locations, allows companies to become preform producers and to sell to stretch-blow moulding producers. Thus companies that wish to enter the market with oriented PET containers
25 can minimise their capital requirements. Preform design and its relationship to the final container remains the most

critical factor. The proper stretch ratios in the axial and hoop directions are important if the container is to properly package its intended contents. Exemplary ratios are as follows:-

Material	Stretch Ratios	Orientation Temp. Deg. F
PET	16/1	195-240
PVC	7/1	210-240
PAN	9/1	220-260
PP	6/1	260-280

5

Conventionally, for PET containers such as bottles which either have no handle or to which a handle is attached as a subsequent production step after blow-moulding, the preform is generally in the form of an elongate hollow cylinder closed at its lower end and formed with a neck portion adapted to accept a closure means such as a screw-on cap. Thus for example as shown in figures 1A and 1B, the neck portion has a threaded section 15 and typically a retaining ring 16. The retaining ring 16 is adapted to provide location of the preform in the stretch-blow-moulding die.

The injection moulding process is conventional in that the outer shape of the preform is defined by a cavity formed in two mating halves of the injection die, and the internal shape defined by a mandrel, the space between cavity and mandrel defining the wall thickness and neck detail of the preform. Molten PET is injected into this space and the die opened and the preform ejected off the

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mandrel after which the preform is allowed to cure. A typical cavity 20 and mandrel 21 for a PET bottle preform is shown in figure 2 which shows a portion of one half 22 of a typical single cavity injection die.

5 By contrast, the preform injection die cavity 30 of a preferred embodiment of the present invention incorporates a handle portion 31 as illustrated in figure 3, between a first upper junction point 32 with the preform somewhat below the neck portion 33 and rejoining the elongated
10 cylindrical portion of cavity 30 at a second lower junction point 36. The preferred generally arcuate form of the handle portion 31 and the distance between the first and second junction points 32 and 36 is such as to allow space for at least some fingers of the hand to pass between the
15 handle and the side of the container when formed.

Again with reference to figure 3, a main mandrel portion 37 of a mandrel assembly, that is the elongate cylindrical mandrel which will form the body of the container, is provided with an internal passage 38. Passage
20 38 extends from a control module 39, preferably mounted external to the injection die body 40 to end in curved portion 41 and communicating with opening 42 in the external surface of main mandrel 37 at first junction point 32. A collapsible handle mandrel 43 is inserted downwardly
25 through passage 38 to emerge from main mandrel 37 at first junction point 32. Collapsible handle mandrel is shown in

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figure 3 in its initial retracted position with tip 44 just inside opening 42.

Collapsible handle mandrel 43 is formed of a flexible heat resistant material with shape memory characteristics.

5 The lower portion of handle mandrel 43 has been pre-conditioned to assume a shape conforming to the median axis of the handle cavity 31 when not otherwise constrained. Thus when the lower portion of handle mandrel 43 emerges from the opening 42 it assumes that pre-conditioned shape.

10 Handle mandrel 43 is fed to emerge from opening 42 to take up the form as indicated by dashed lines in figure 3 and sufficient for its tip 44 to come into contact with main mandrel 37 at second junction point 36. Main mandrel 37 is provided with pocket 45 adapted to accept and locate the

15 handle mandrel tip 44. Handle mandrel is of a cross section so as to leave a space between the handle mandrel 43 and the handle cavity 31.

The movement of handle mandrel 43 through passage 38 and into handle cavity 31 is controlled by handle mandrel

20 control module 39 mounted to an extension 47 of the main mandrel 37. At the commencement of an injection cycle, the die closes and the control module causes handle mandrel 37 to feed out of opening 42 and take up the position as shown in figure 3. PET is now injected into the mould cavity to

25 define a preform complete with hollow handle as shown in figure 4.

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Prior to, or at the opening of the injection die at the end of the mould cycle, the collapsible handle mandrel is withdrawn from the handle cavity to be wholly within the main preform mandrel (as shown in figure 3). This allows
5 the preform to be ejected from the main mandrel leaving a preform with a hollow handle in communication with the interior of the elongate cylindrical main body of the preform.

After curing the preform may be subjected to the
10 second stage of the bottle forming process. Following a suitable preparation phase where the temperature of the preform is brought up to the optimum, it enters a blow moulding cavity 50 as shown in figure 5. The cavity defines the final shape of the bottle. As can be seen the neck
15 portion 51 of the preform is closely confined and not subject to the stretching of the blowing process. Handle portion 52 is also confined to a limited extent by the land 53 between the main body of the preform and the handle but with sufficient clearance to allow a certain amount of
20 stretching of both the handle and the surface of the main body of the preform between the first and second junction points.

Initially, the expandable portion of the preform below the neck can be mechanically stretched downwardly to the
25 bottom of the mould and then the bulk of the preform can be blown outwardly by application of compressed air to the

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extent that the PET material stretches into a thin shell conforming to the cavity.

This stretching of the PET polymer is important for the reasons outlined in the background above, in that it
5 confers desirable properties of tensile strength and impermeability to the walls of the stretch-blow-moulded bottle. As shown in figure 6 after blowing the bottle conforms completely to the shape defined by the stretch-blow moulding cavity.

10 The above describes only some embodiments of the present invention and modifications, obvious to those skilled in the art, can be made thereto without departing from the scope and spirit of the present invention.

CLAIMS

1. A preform for a stretch-blow moulded container
comprised of orientable plastic material and arranged
so that the resultant stretch-blow moulded container
includes an integrally moulded hollow handle; said
preform comprising a moulded structure having a neck
portion and an expandable portion below the neck and a
hollow handle portion; said hollow handle portion
extending from a first upper junction point to a
second lower junction point on said expandable portion
and wherein interior surfaces of said hollow handle
portion form a continuum with interior surfaces of
said expandable portion.
2. A system for the stretch-blow moulding of a container
comprised of orientable plastic material; said
container provided with an integral hollow handle;
said handle being in communication with the interior
of said container at both a first upper junction point
and a second lower junction point.
3. The system of claim 2 wherein said containers are
formed in a two-stage process.

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4. The system of claim 3 wherein a first process of said two-stage process includes producing a preform by injection moulding.
5. The system of claim 3 or 4 wherein a second process of said two-stage process includes producing said container from said preform by stretch-blow moulding of said preform.
6. The system of claim 4 or 5 wherein said preform comprises:
- (d) a neck portion including a threaded upper portion and a locating ring portion,
 - (e) an expandable elongate cylindrical body portion depending from said neck portion and closed at a lower end,
 - (f) a generally arcuate hollow handle portion integrally connected to said elongate cylindrical body portion at a first upper junction point and a second lower junction point.
7. The system of any one of claims 4 to 6 wherein said preform is injection moulded in a mould cavity of an injection die provided with a main body mandrel and a handle mandrel.

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8. The system of claim 7 wherein said main body mandrel is adapted to define internal surfaces of said elongate cylindrical body portion.
- 5 9. The system of claim 7 wherein said handle mandrel is adapted to define internal surfaces of said hollow handle portion.
- 10 10. The system of claim 7 wherein said mould cavity is adapted to define external surfaces of said elongate cylindrical body portion and said arcuate hollow handle portion.
11. The system of claim 7 wherein said main body mandrel is of an elongate cylindrical form; the upper end of said elongate cylindrical form extending through said neck portion so as to communicate with a handle mandrel control module external to said injection die.
- 15 12. The system of claim 11 wherein said main body mandrel is provided with an internal passage passing from said handle mandrel control module to said first upper junction point below said neck portion; said internal passage curving outwardly to end at an opening in the external surface of said main body mandrel.
- 20 13. The system of claim 12 wherein said handle mandrel is comprised of a heat resistant, flexible shape

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retaining material adapted for sliding insertion through said internal passage..

14. The system of claim 13 wherein said flexible shape retaining material of said handle mandrel is
5 conditioned to form a lower portion of said handle mandrel so as to conform to a median line of said hollow handle portion when said lower portion is unrestrained.
15. The system of claim 14 wherein said lower portion of
10 said handle mandrel is adapted for sliding extension from said internal passage to adopt a shape conforming to said median line; a lower tip portion of said lower portion adapted to nest in a pocket provided in said main body mandrel at said second lower junction point.
- 15 16. A method for the production of a preform for a blow-stretch-moulded container having an integral hollow handle said method including the steps of:
- (f) Placing a mandrel assembly comprising a main
20 mandrel portion and a retractable handle mandrel portion within a preform injection moulding cavity; said cavity having a main body portion and a hollow handle portion,

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- (g) Extending a retractable handle mandrel portion from said mandrel assembly so as to define a median line of said hollow handle portion,
- (h) Injecting PET into said cavity so as to fill voids between said cavity and said mandrel assembly so as to form said preform,
- (i) Retracting said retractable handle mandrel portion to within said main body portion of said mandrel assembly,
- (j) Ejecting said preform off said mandrel assembly.
17. The method of claim 16 wherein said retractable handle mandrel portion is adapted for extension between a first retracted state within said main body portion of said mandrel and an extended state wherein said handle mandrel defines said median line of said hollow handle portion.
18. A method for the production of a container having an integrally formed hollow handle by a two-stage process; said process including the steps of:
- (c) preparing a preform having a hollow handle portion by injection moulding,
- (d) stretch-blow-moulding said container.

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19. The method of claim 18 said method including the further steps of;

(e) injection moulding said preform around a mandrel assembly having a main body portion and a handle portion,

(f) retracting said handle portion into said main body portion,

(g) ejecting said preform from said mandrel assembly,

(h) placing said preform into a stretch-blow-moulding die,

(i) stretch-blow-moulding said container.

DATED: 29 October 2003

B & R Industries Pty Ltd

by their Patent Attorneys:

WALLINGTON-DUMMER

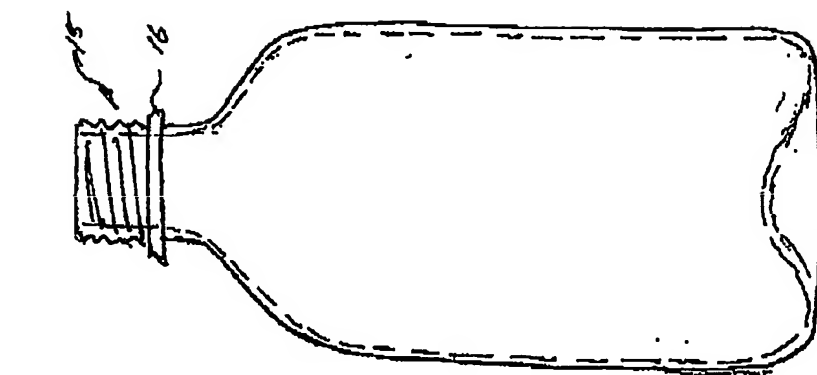
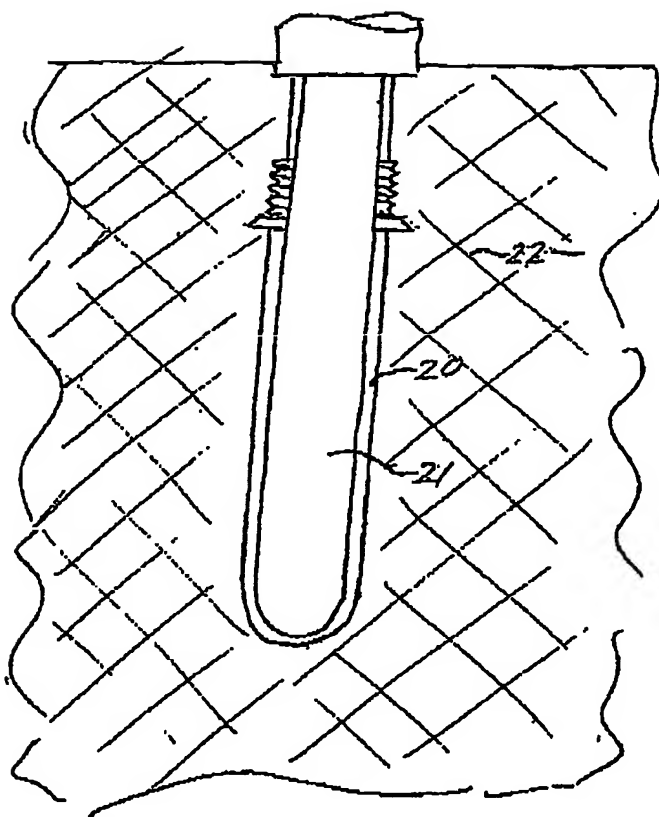
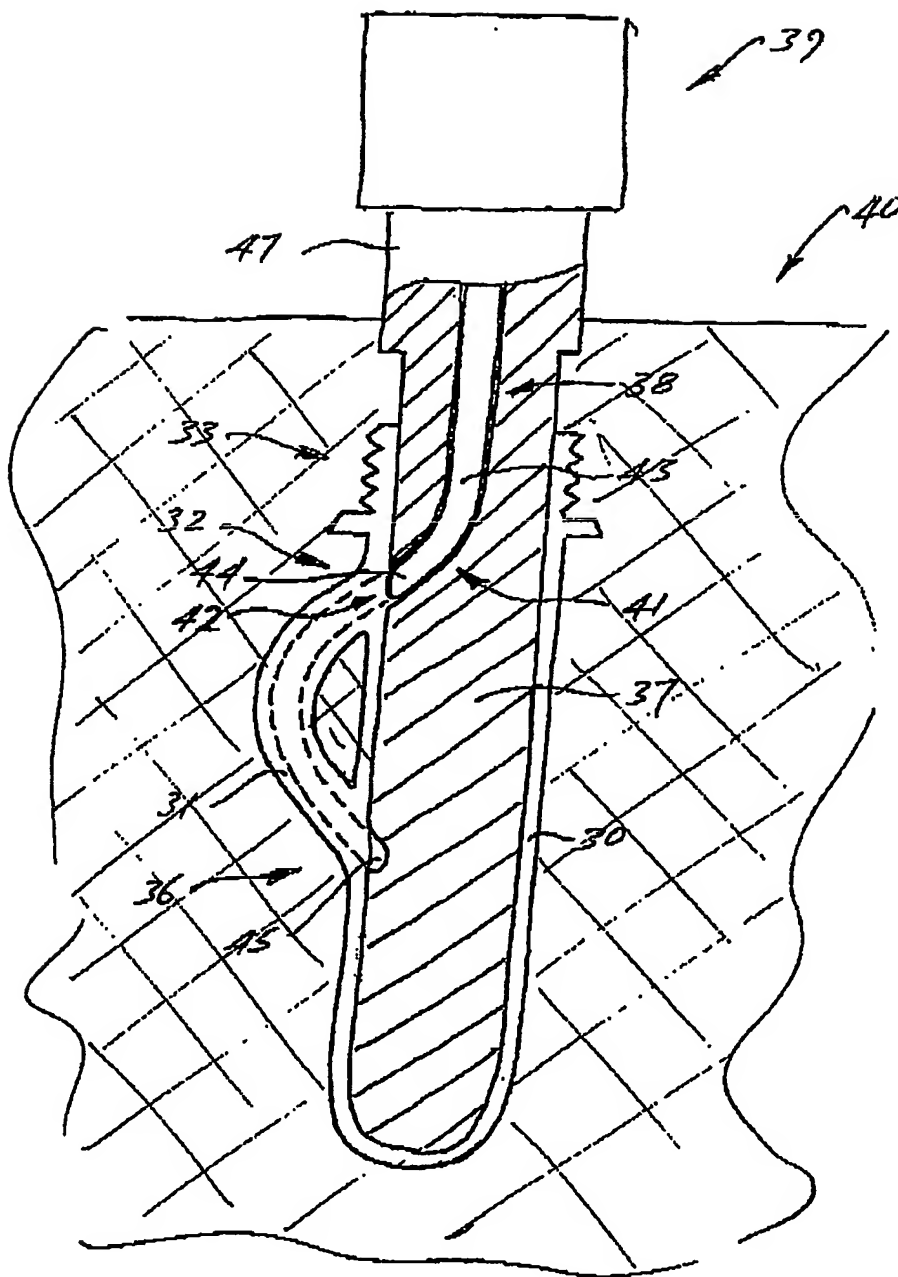


Fig. 1B

PRIOR ART

*Fig. 2*

Fig. 3

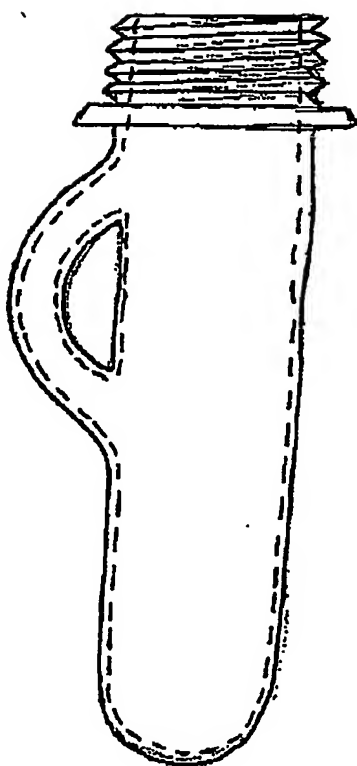
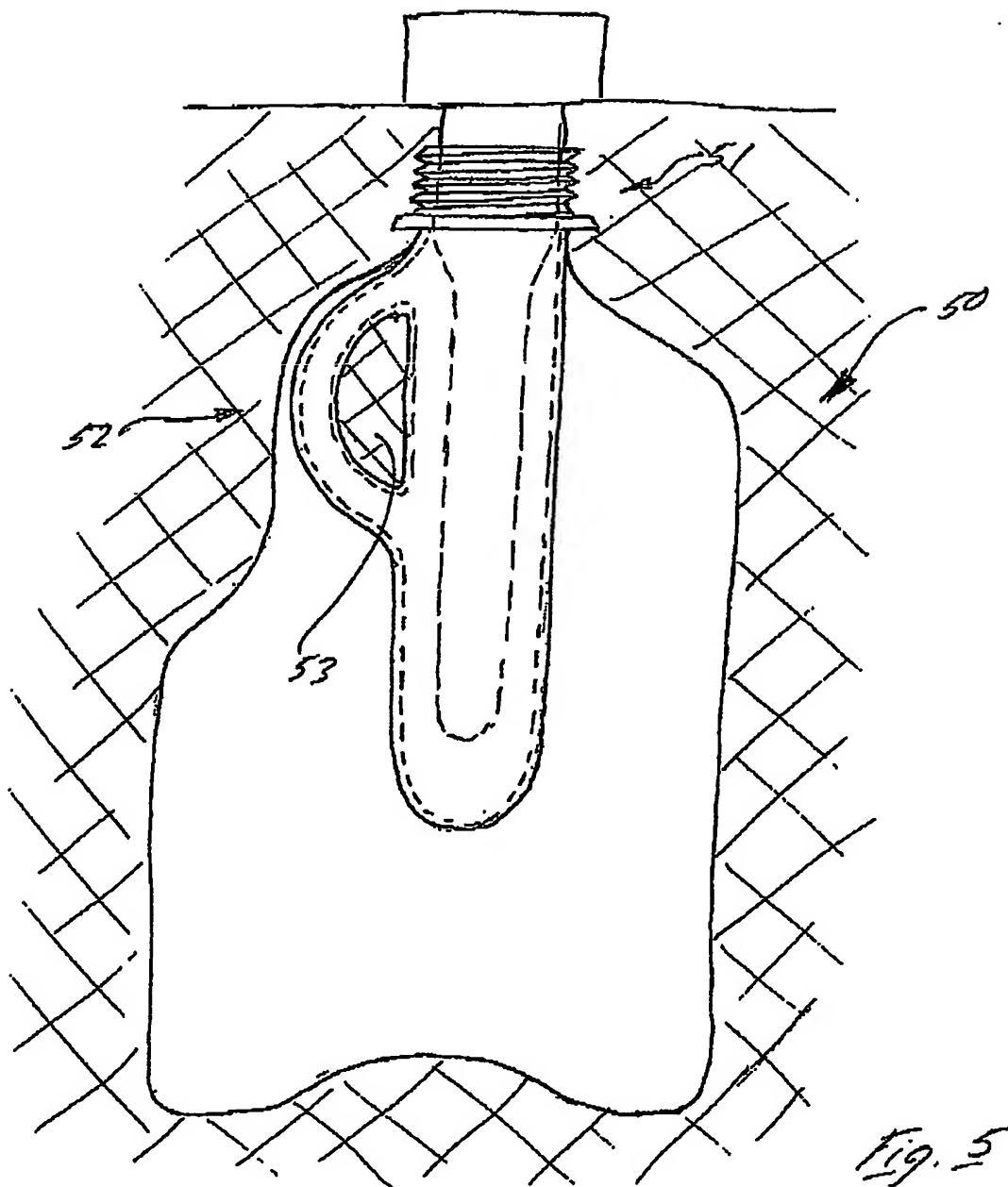


Fig. 4



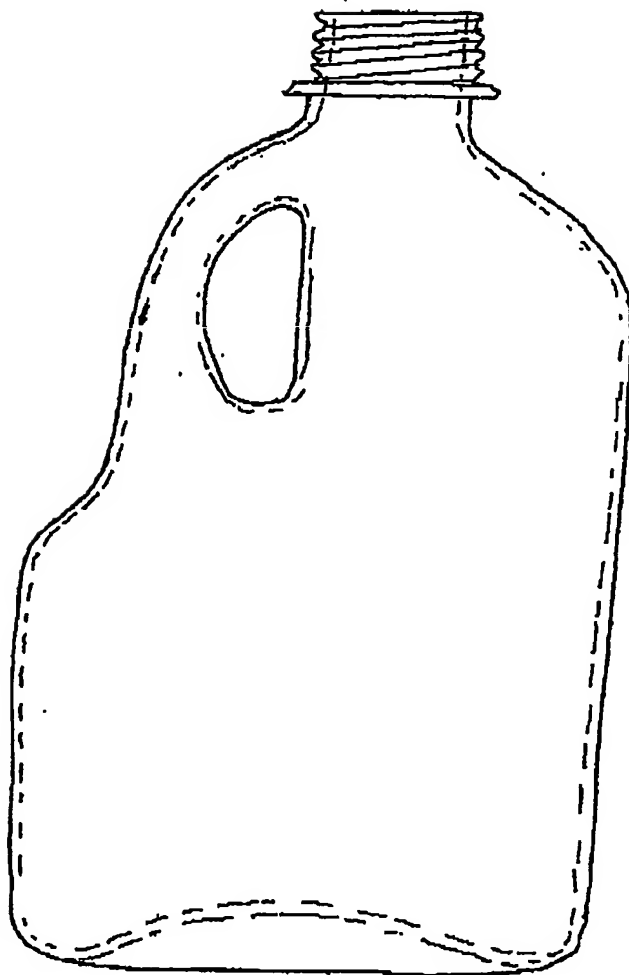


Fig. 6

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